William Thomson, Baron Kelvin of Largs, was born at Belfast, June 24, 1824. He was the second son of James Thomson, who, descended from a small farmer in the north of Ireland, in 1832 became Professor of Mathematics in the University of Glasgow. The James Thomson who in 1872 succeeded Rankine as Professor of Engineering at Glasgow was Lord Kelvin's elder brother. In 1834 he became a matriculated member of the University, and at the age of 15, during a fortnight's visit to Germany, he read Fourier's treatise to such purpose that soon after his return he wrote a series of papers in which he successfully defended Fourier from a charge of unsoundness brought against him, through some misconception, by a very competent mathematician. In 1841 he proceeded to Peterhouse, Cambridge; he was very youthful-looking and was known as "the pretty boy," but, despite his youth, he won the Colquhoun Sculls in 1843, which, it is interesting to note, had been won the previous year by the Hon. G. (afterwards Mr. Justice) Denman. He was also one of five Peterhouse men who founded the University Musical Society, the only survivor being Bishop Cridge of Victoria, B.C., who is now 86. While still an undergraduate he published papers in the *Cambridge Mathematical Journal* on the Motion of Heat, and the Mathematical Theories of Electricity and Attractions. In 1845 he graduated as Second Wrangler and first Smith's prizeman; he was almost immediately elected a Fellow of his College, and then he spent a short time in Regnault's laboratory in Paris. The next year he was appointed to the Chair of Natural Philosophy at Glasgow, which he continued to hold for fifty-three years; on resigning the Professorship he applied to be appointed as a research student; and in 1904 he was installed as Chancellor of the University.

To give even the titles of the papers he published on various branches of mathematics and physics, and the names of the instruments he invented, would require more space than could be allotted to this notice. His great strength lay in the wonderful faculty he possessed for directly applying the results of the most abstruse mathematical investigations to the solution of practical problems, and in the mechanical ingenuity which enabled him to invent instrument after instrument which satisfied, almost to perfection, the requirements indicated by the most refined analysis. It was Professor Newcomb who said, on the occasion of Lord Kelvin's jubilee in 1896: "It has been the general—I do not know but that it has been the almost universal—rule that the men who have by their studies and thought promoted our knowledge of nature, have not been those who have applied that knowledge to the direct benefit of mankind. I am not sure but that Lord Kelvin is the single, solitary exception to this rule."

His direct contributions to Astronomy were not numerous compared with the rest of his work, but he has told us that he learnt from Stokes before the end of 1851 that the existence of the D line in the solar spectrum proved the presence of sodium in the Sun, and from that date he regularly taught this fact in his

lectures; Kirchoff's work was not published until 1859. In 1862 he presented a paper to the Royal Society of Edinburgh in which he showed from the equations representing the conduction of heat in a solid that the present distribution of underground temperature necessarily implied a finite limit to the age of the Earth, and he fixed the date of its consolidation at between twenty and four hundred millions of years ago. An address on Geological Time, given to the Geological Society of Glasgow in 1868, led to a lively controversy with Huxley, in which he maintained that the fact that the oblateness of the Earth corresponds with the present length of the day shows that the Earth could not have been rotating with much greater velocity when it solidified, and that the retardation due to tidal friction therefore enables us to assign a limit to the time within which this must have happened. He also endeavoured, by means of the conservation of energy, to fix a limit to the time during which the Sun could, by its radiation, have kept the Earth at a temperature at which organic life is possible. It should, however, be mentioned, with regard to the argument from the figure of the Earth, that Sir George Darwin believes the Earth to have a greater power of adjusting its figure to its rate of rotation than Lord Kelvin thought possible. It was just after the conclusion of this controversy that Huxley introduced Sir William Thomson (as he then was) as his successor in the Presidency of the British Association with the words, "gentler knight never broke lance." Returning to the same subject thirty years later, with a more complete knowledge of underground temperature, Lord Kelvin placed the date of solidification at "more than twenty and less than forty millions of years ago, and probably much nearer twenty than forty." The discovery of the properties of radium has, however, diminished the force of these arguments, whether derived from the conduction of heat in the interior of the Earth, or from the age of the Sun's heat.

These investigations, as well as the principle of the dissipation of energy, which was stated in a paper presented to the Royal Society of Edinburgh in 1852, and in the *Philosophical Magazine* for the same year, have a direct bearing on cosmical physics and on the evolution of stellar systems.

Lord Kelvin also gave much attention to the rigidity of the Earth, as evidenced by the phenomena of precession and the tides. He took up the former problem where it was left by Hopkins, and, by amending his argument, he showed that it led to the conclusion that either the globe is solid throughout, or else the crust yields with nearly the same freedom to external forces as if it were liquid. He then compared the heights of oceanic tides on a perfectly rigid globe with those on globes possessing the rigidities of glass and steel respectively, and, from the best data available, concluded that the average stiffness of the Earth is greater than that of glass, but perhaps not greater than that of steel. His work on the Tides in general and the construction of his "Tide Predictor" afford a very good illustration of his

power of first dealing with theory and then translating it into practice.

He effected many improvements in navigation. He published a set of tables for facilitating the use of Sumner's method for determining the position of a ship. In 1876 he patented a compass in which the single, large, strongly magnetised needle formerly used is replaced by eight small parallel magnets of comparatively feeble intensity; he was thus able to secure lightness and long vibrational period, giving greater steadiness to the compass; the short needles allowed the correction to be accurate on all courses of the ship, for the place where the adjustment was made, and the small magnetic moment allowed the correction of the quadrantal error to remain accurate for all parts of the world. As an illustration of his attention to minute details, it may be noted that 32 radial slits were given to the card to prevent warping. This compass is now in almost universal use, as is also the deep-sea sounding apparatus, which is frequently the only means by which a sailor can determine his position when neither land nor sky is visible.

One of the greatest of the indirect benefits which Lord Kelvin conferred upon Astronomy was through ocean telegraphy, which has rendered possible the accurate determination of longitudes. To this achievement he contributed more than any other person, whether by demonstrating its theoretical possibility in opposition to Sir George Airy, by showing that the shortness of the life of the first Atlantic cable of 1858 was due to the intensity of the currents used in signalling, or by his invention of the mirror galvanometer and siphon recorder, which rendered possible the use of comparatively feeble currents.

He was knighted in 1866 as a recognition of his services in connection with the first Atlantic cables of 1858, 1865, and 1866. He had been elected a Fellow of the Royal Society in 1851; he subsequently received a Royal and a Copley medal, and was elected President in 1890. He was President of the Royal Society of Edinburgh 1887–90, and again from 1895 to the time of his death, and President of the British Association at the Edinburgh meeting in 1871. In 1892 he was created a Peer, taking his title from the small stream at the foot of the hill on which the University of Glasgow stands. He was one of the first recipients of the Order of Merit at its creation in 1902, and he became a Privy Councillor in the same year.

Nothing could show more clearly the estimation in which Lord Kelvin was held, both at home and abroad, than the celebration of the jubilee of his professoriate at Glasgow in 1896. Delegates from all parts of the world presented addresses; those from the Institute of France brought the Arago medal, which had been bestowed upon only three previous recipients. Congratulations were received from the Queen and the Prince of Wales, and telegrams from Europe, Asia, Africa, America, and Australasia.

Lord Kelvin was twice married: first to Margaret, daughter of Mr. Walter Crum, of Thornliebank; and secondly, to Frances Anna,

daughter of Mr. Charles R. Blandy, of Madeira. There was no issue of either marriage. He died at Netherhall, Largs, on December 17, and was laid to rest in Westminster Abbey on December 23; his grave is by the side of that of Sir Isaac Newton.

He was elected a Fellow of the Society 1868 November 13.

S. A. S.

David Joseph Kennelly was born at Cork, Ireland, on October 1, 1831, and was the son of David Nugent Mountjoy Kennelly and Zaida Teresa de la Romana Kennelly, *née* Marquesa de la Romana, of Las Palmas, Minorca. He went to sea as midshipman in 1846, and was rapidly promoted in the service of the Royal East India Company's Navy. He was made second sailing-master of H.M.S. *Meteor* in 1849, and, as master of the frigate *Ferooz*, in 1853 conveyed the 10th Lancers from Cananore to Suez, on their way to the Crimea. In the same year he served on board the frigate *Akbar* on an expedition to the Persian Gulf and the Euphrates, bringing to Bombay Layard's Nineveh slabs now in the British Museum. He was accustomed to compute the daily longitudes as well as latitudes mentally, with the aid of the regular tables, but without pencil or paper. The science of astronomy especially interested him in relation to navigation.

At the outbreak of the Indian Mutiny in 1857 Captain Kennelly was Naval A.D.C. to the Governor of Bombay. He was immediately sent, as master of a frigate, with despatches to the General commanding at the Cape of Good Hope, calling for such troops as South Africa could spare. He brought back to India H.M. 89th regiment of infantry, and landed them into action at the Gulf of Cambay. Returning to Bombay, he assisted in the disarmament of three mutinous sepoy regiments. He was twice mentioned in despatches in recognition of services.

After the Indian Mutiny, Captain Kennelly was appointed a Joint Commissioner of Bombay, and master-attendant in charge of H.M. dockyard at that port. He held this appointment until he retired from Indian service in 1868 and returned to Great Britain. He studied law in London from 1872 to 1876, and was admitted to the bar at the Inner Temple, pleading for some years in the Admiralty Court at Westminster. Later he became a barrister of the Supreme Court of Nova Scotia, and was appointed a K.C. of the province of Cape Breton. He made his home in Louisburg, Cape Breton, and was for many years connected with the coal-mining industries of that province.

Captain Kennelly received a diploma from the University of Bombay, and was at the time of his death the senior honorary corresponding member of the Royal Geographical Society, whose diploma he received for Oriental geographical research. He died at Sydney, Cape Breton, on August 27, 1907, bequeathing a fund for the maintenance and preservation of a portion of the old French citadel at Louisburg, Cape Breton, and for the protection of its historical relics. He had already presented the land for this pur-